Network Analyst: Solving Transportation Analysis Problems with Public Transit Data

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SEE WHAT OTHERS CAN'T

Agenda

Outline

- Background information
- Creating a network dataset with public transit
- Example analysis: Analyzing access to jobs by public transit
- Other cool things

Topics

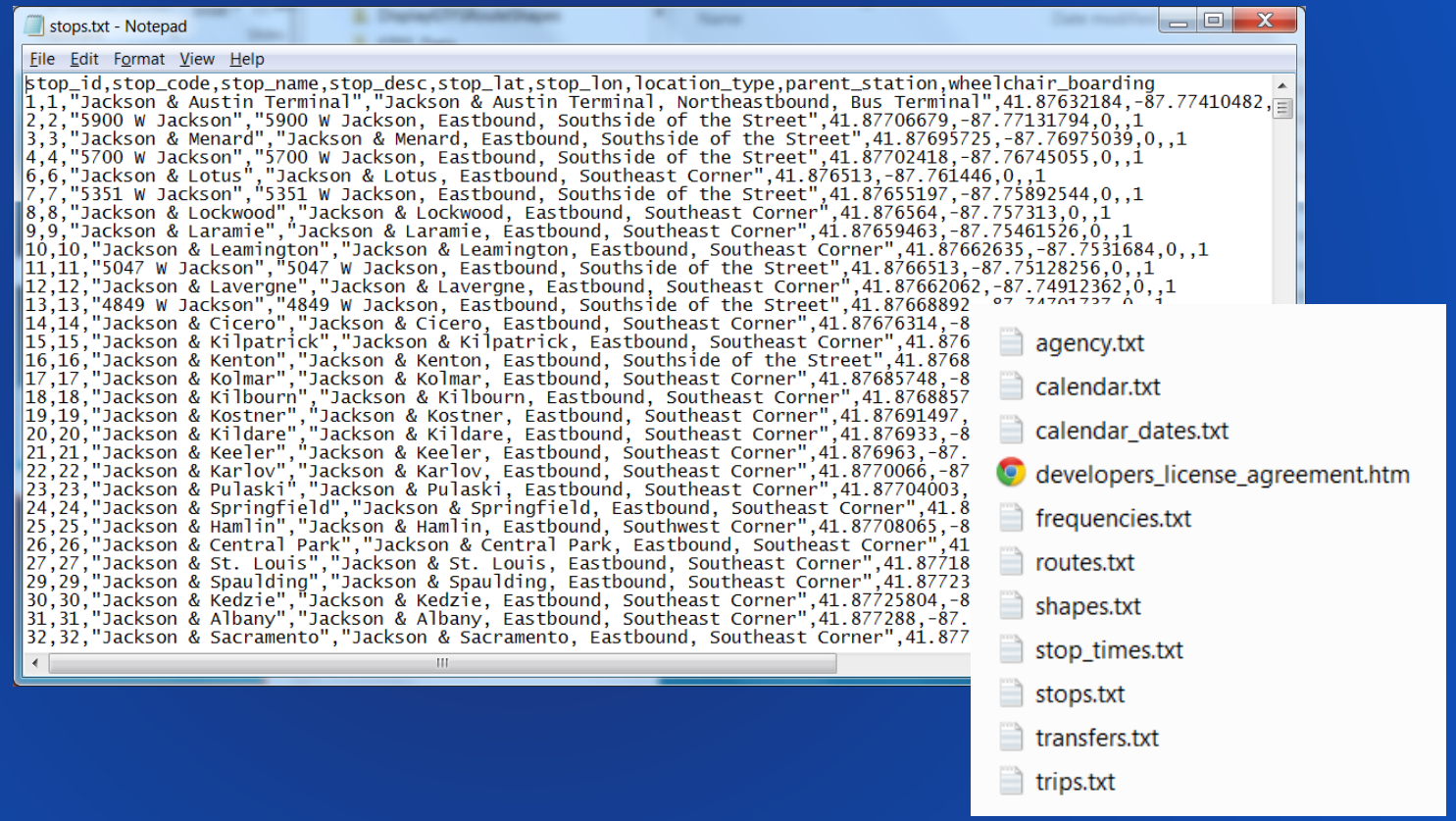
- GTFS data
- Network Analyst
- Public transit data model
- Network datasets
- Service areas

Background Information

GTFS public transit data

Stops, routes, & schedules

- **Standardized**
- **Simple**
- **Widespread**



Download directly from the transit agency or from transitfeeds.com

ArcGIS Network Analyst Extension

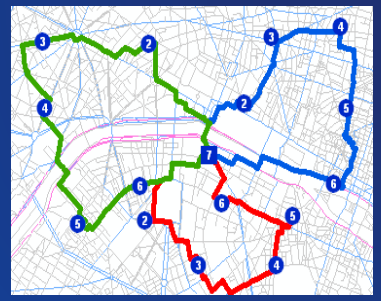
for transportation analysis

Coverage

Service Area

Optimization

Location-Allocation



Vehicle Routing Problem

Point-to-point routing

Route

Closest Facility

Origin-Destination Cost Matrix

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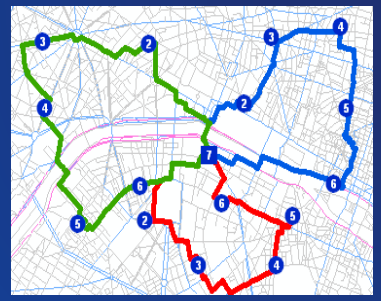

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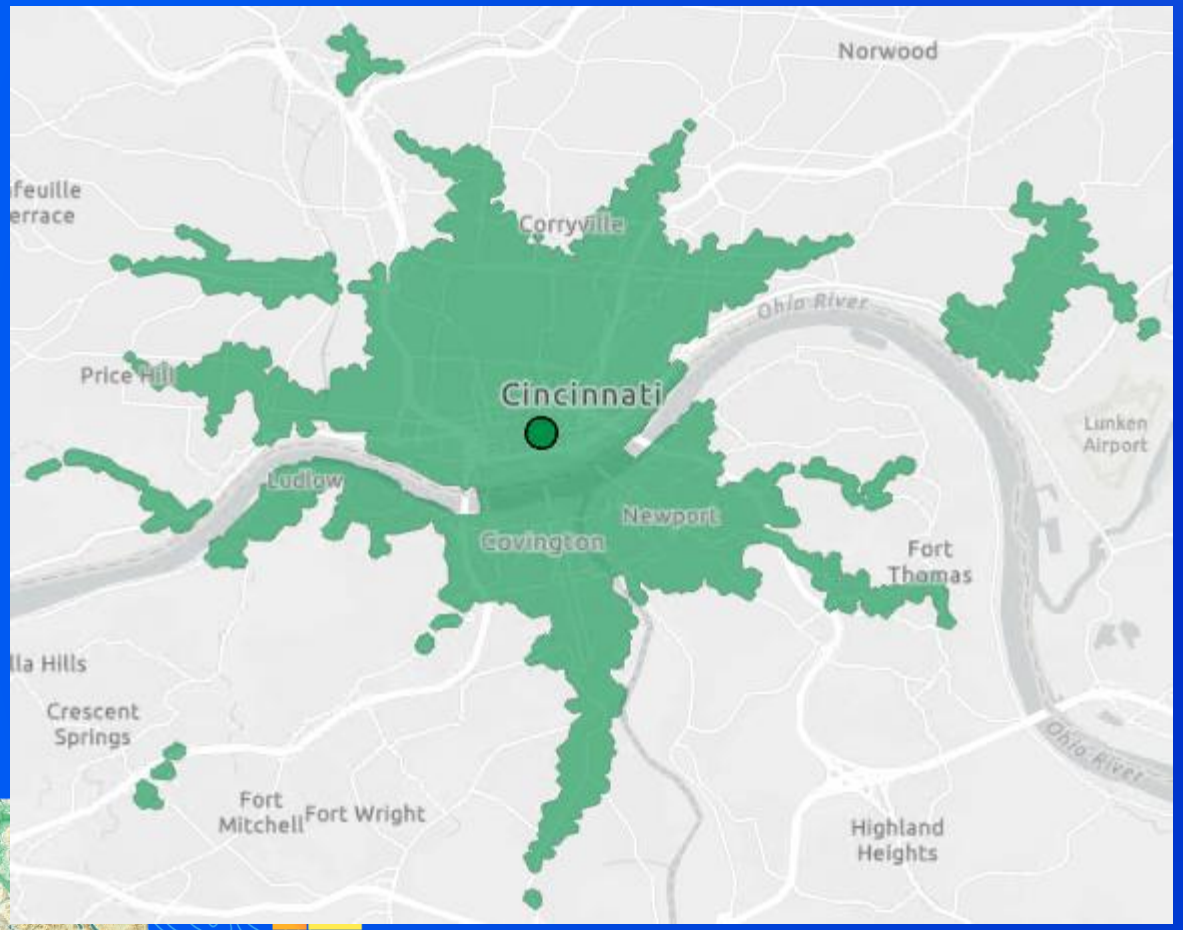
Network Dataset



Demo: Where can I reach by public transit?

Creating a network dataset with public transit

There’s a tutorial!!

http://esriurl.com/TransitTutorial

Creating a network dataset with public transit data

Procedure

Inputs:

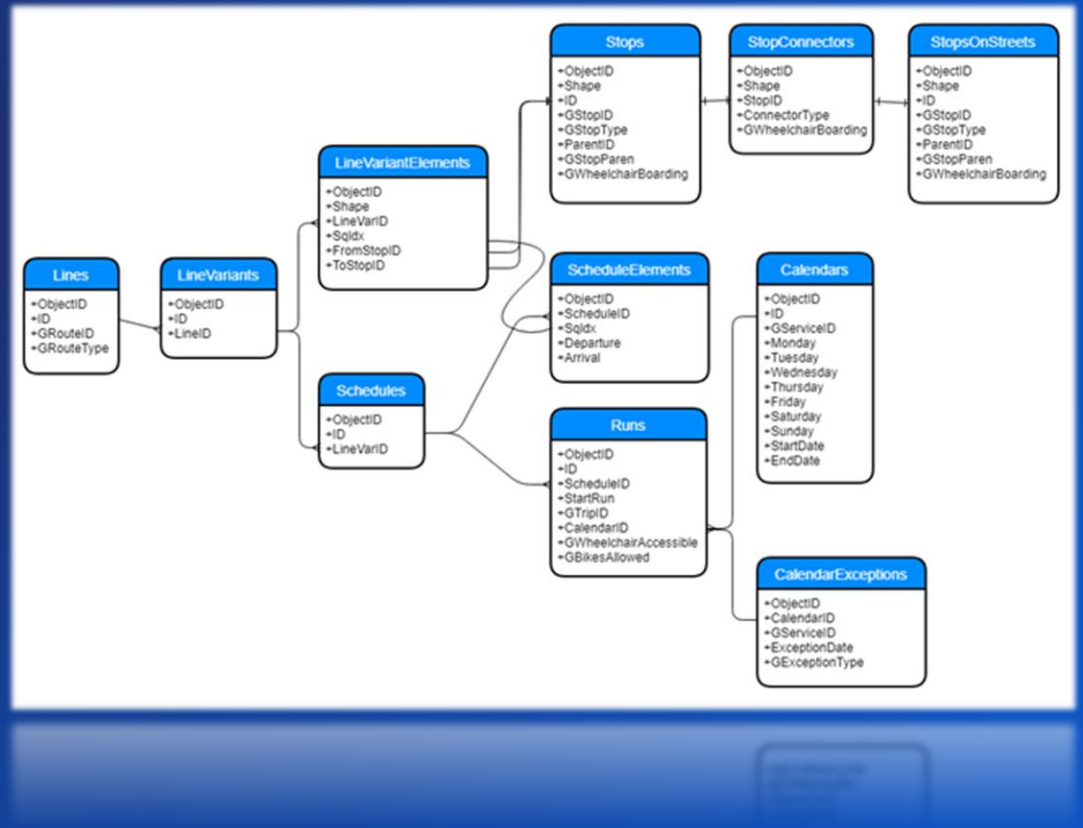
- Public transit data (GTFS or other format)
- Street centerlines

Procedure:

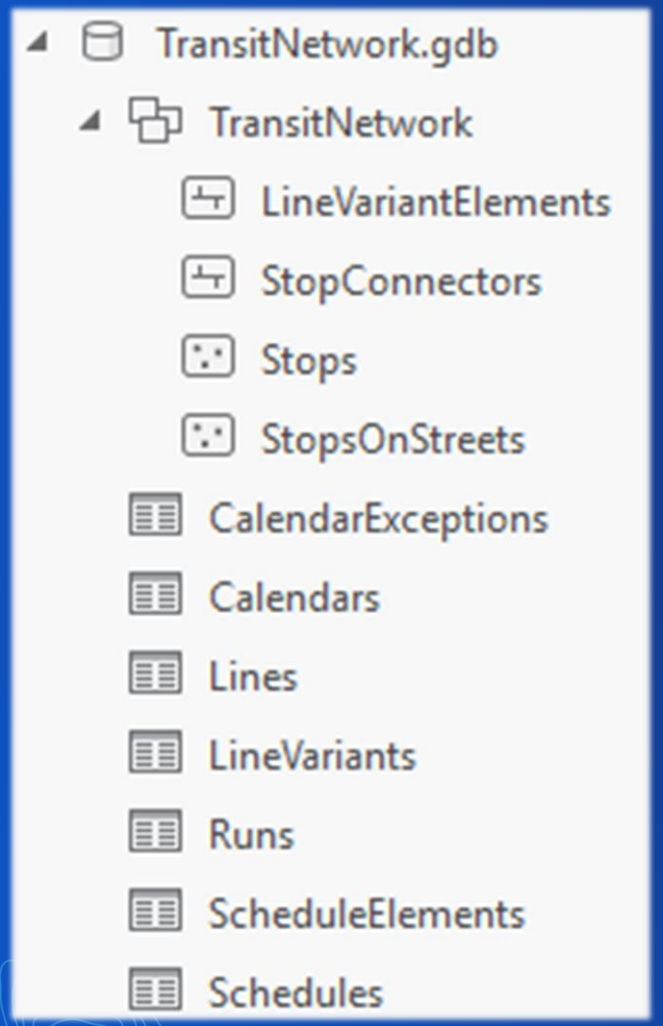
1. Convert transit data into the Network Analyst public transit data model
   a. GTFS To Network Dataset Transit Sources
   b. Connect Network Dataset Transit Sources To Streets
2. Create network dataset using a template
3. Adjust network dataset properties
4. “Build” network dataset

Network Analyst Public Transit Data Model

- Feature classes and tables
- Defines transit stops, lines, and schedules
- Must have specific names and schemas
- See documentation for details

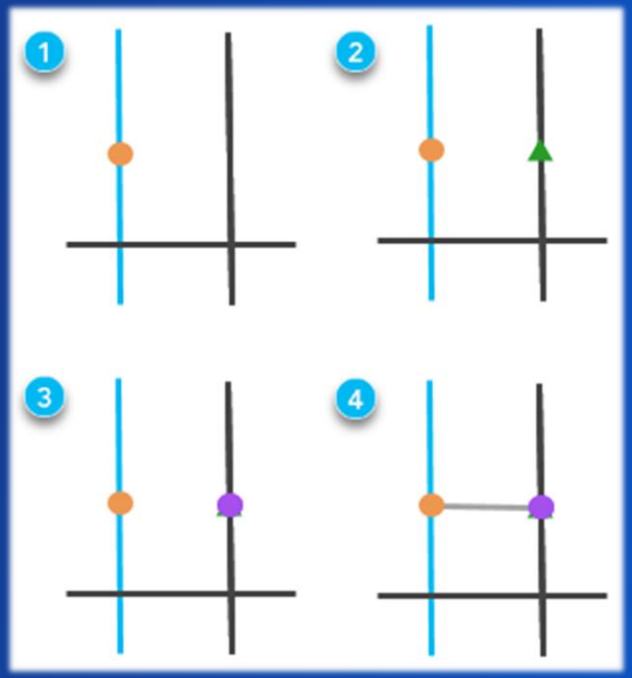


Network Analyst Public Transit Data Model

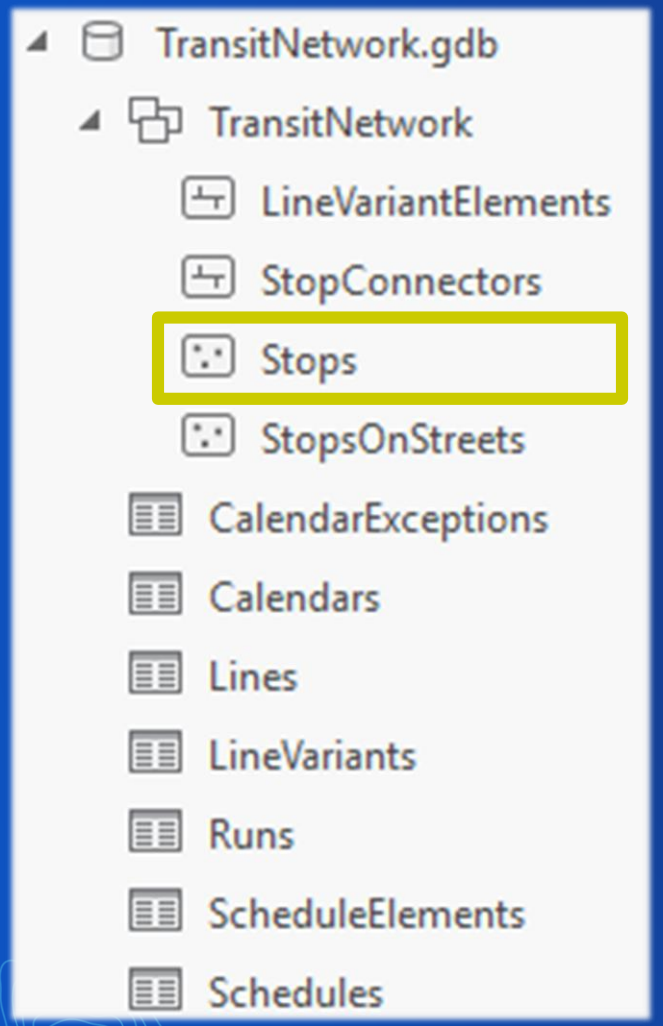


Transit lines and stops; connections from stops to streets

Transit schedules



Network Analyst Public Transit Data Model



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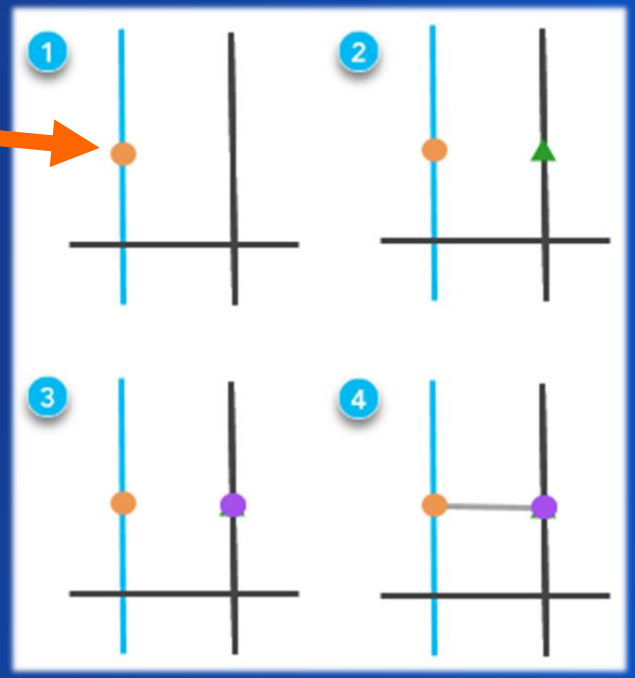

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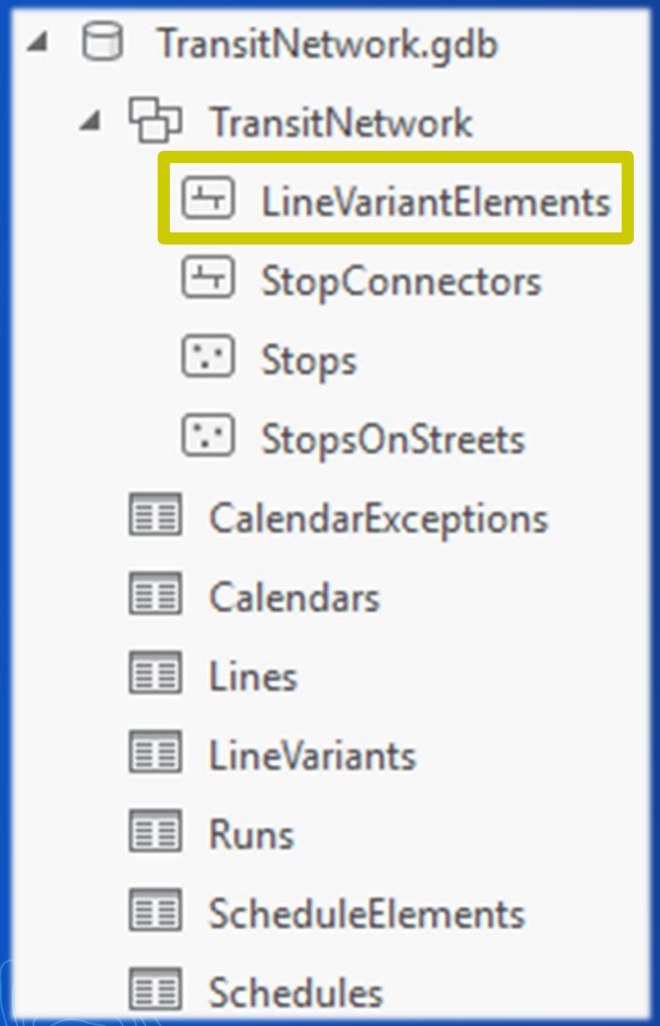

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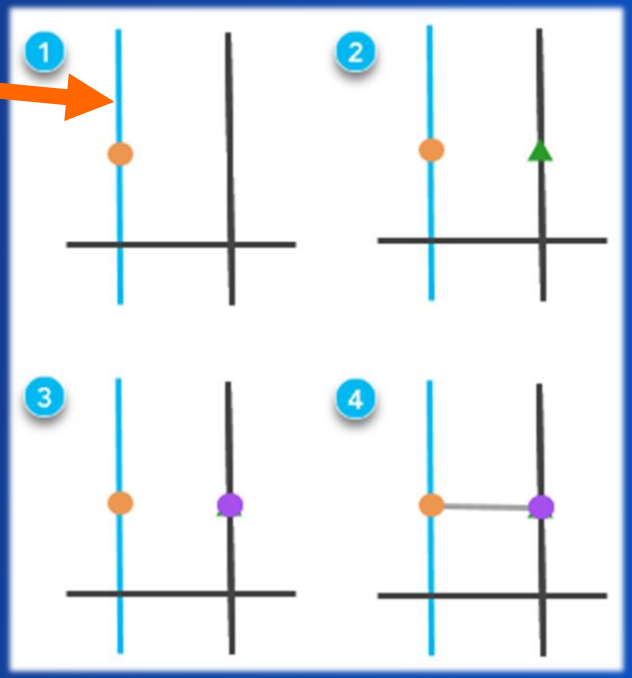
Transit schedules



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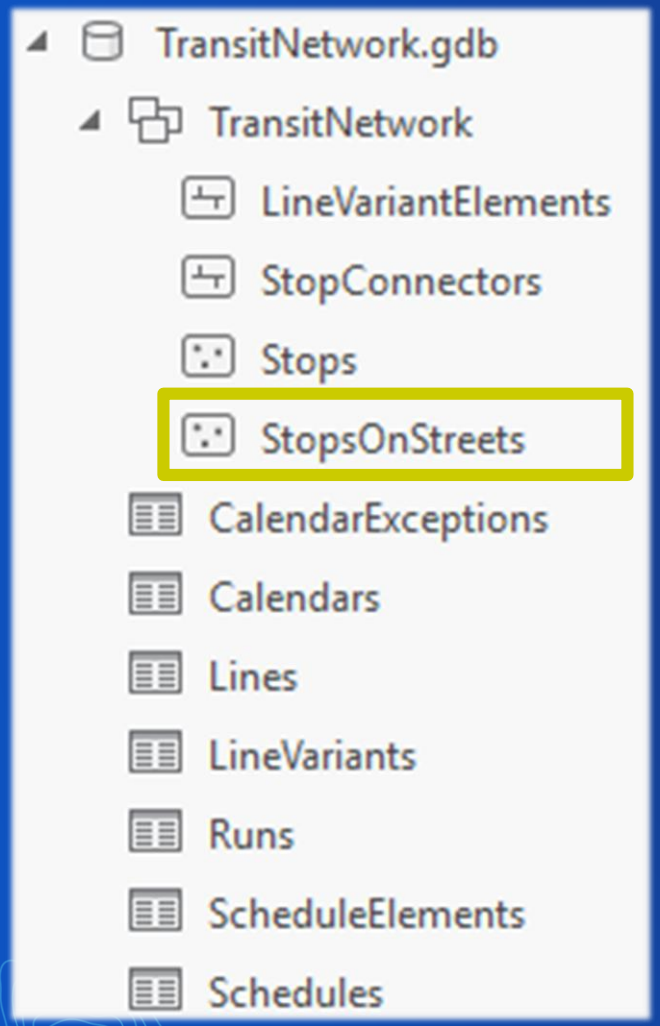

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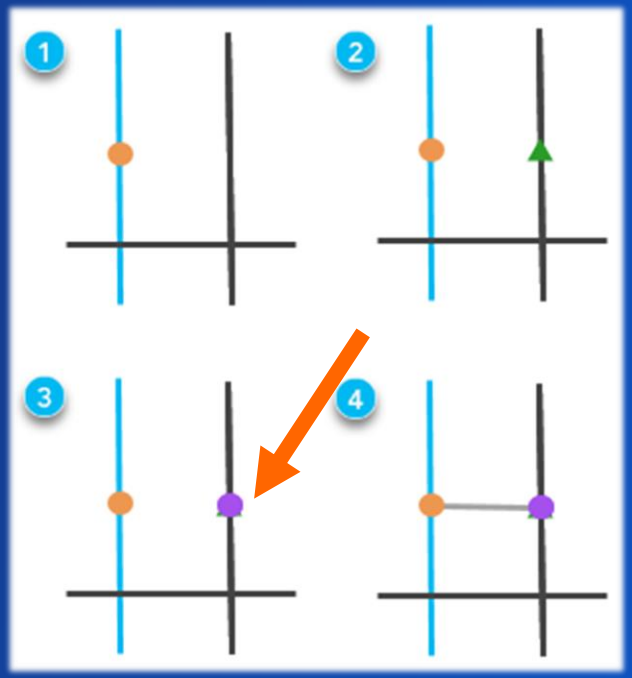
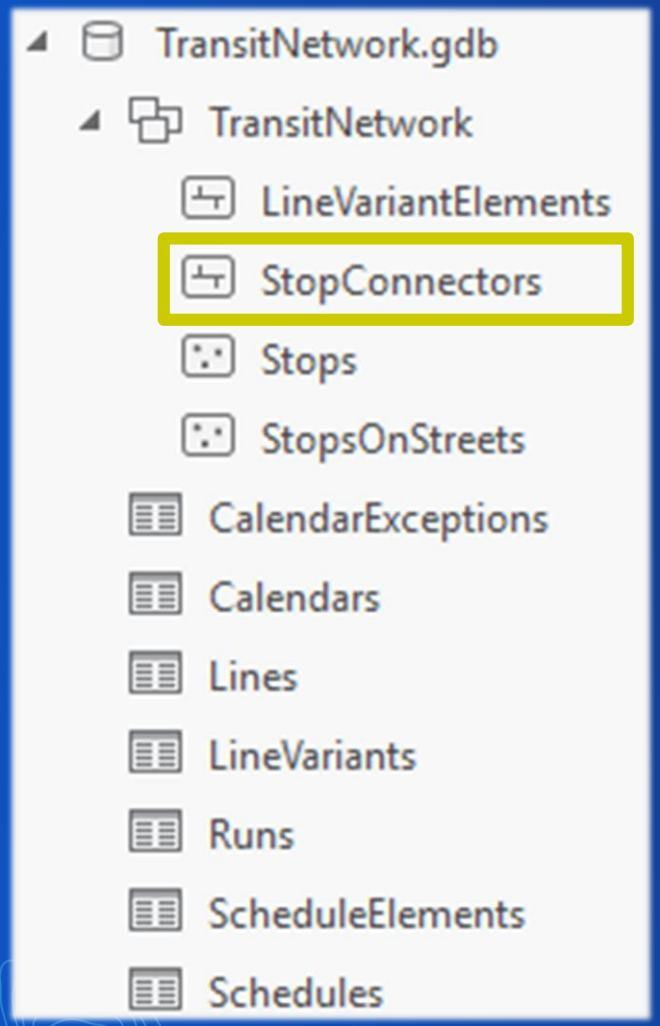


Network Analyst Public Transit Data Model



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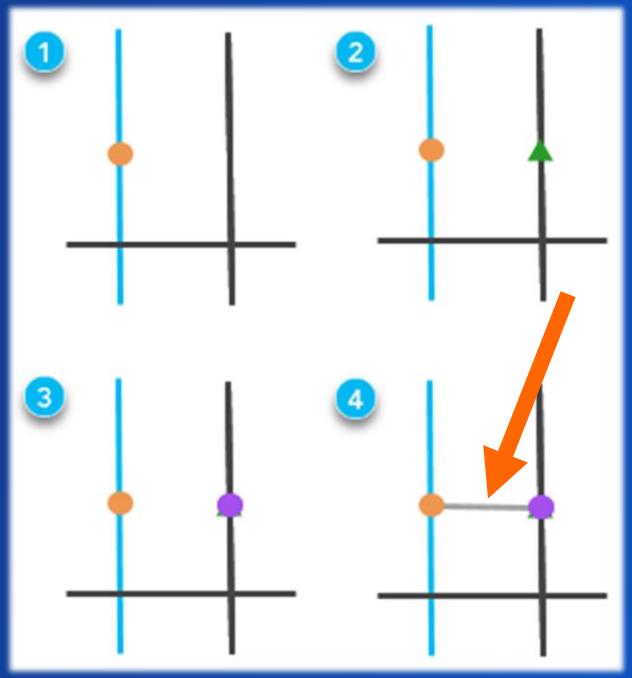
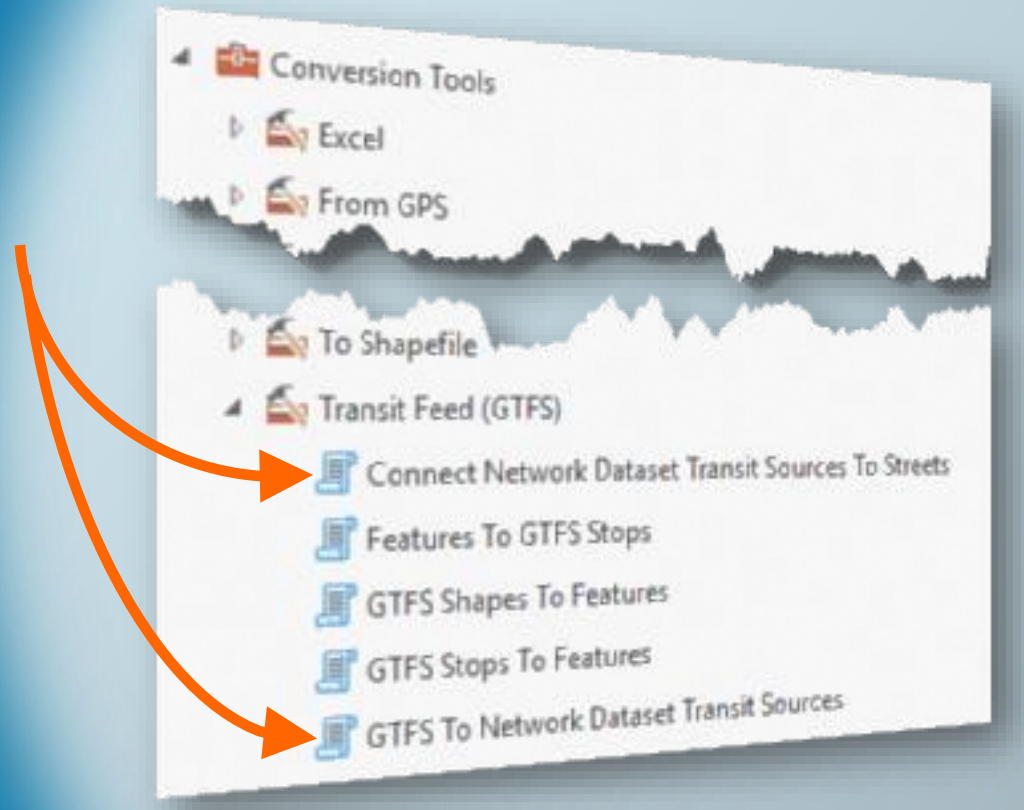


Converting from GTFS to the public transit data model

- Tools:
  - GTFS To Network Dataset Transit Sources
  - Connect Network Dataset Transit Sources To Streets
- In the Conversion Tools toolbox in “Transit Feed (GTFS)” toolset
  - Transit dataset
- Recommended to use these tools, but not required



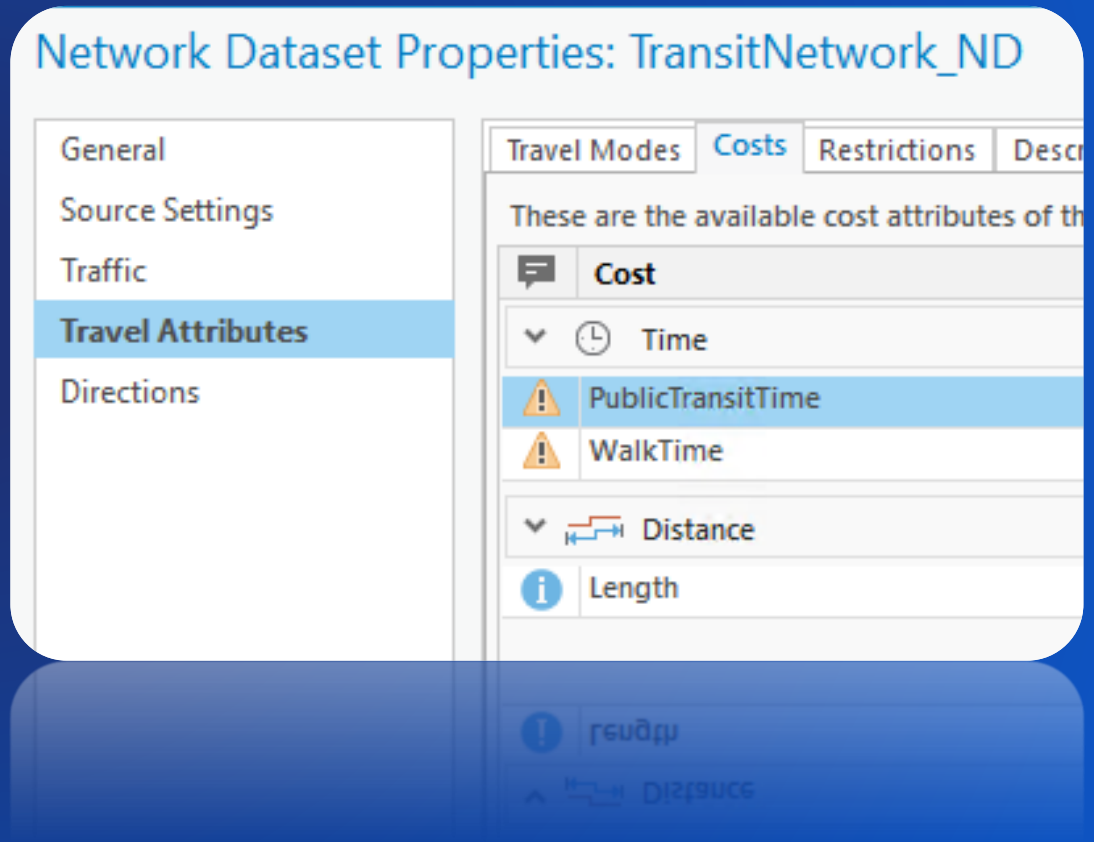

Springdale Rd
Groesbeck
North College Hill
W Galbraith Rd
126
Reading
E Galbraith Rd
Montgomery Rd
White Oak
Kenwood
Madeira
Dent
74
Race Rd
Miami Ave
Mt Airy Forest
Norwood
900 ft
Taylor Rd
264
Werk Rd
Ebenezer Rd
Terrace
Rapid Run Rd
Newtown
Clough Pike
Lawyer Rd
Lunken Airport
Bender
Foley Rd
50
120
Fort Thomas
Mt Washington
River Rd
Villa Hills
275
71
163
Mary Ingles Hwy
Johns Hill Rd
Fort Wright
Highland Heights
1998
Kellogg
Donaldson

Creating the network dataset

- Use xml template with the Create Network Dataset From Template tool
- Obtain template from the tutorial: http://esriurl.com/TransitTutorial

What is a cost attribute?

- How much does it cost to travel along a network edge
- Could be time, distance, or other units
- Network analysis optimizes the solution based on this cost attribute
  - Example: the fastest travel time between two points
- Cost attributes are properties of the network dataset and part of a Travel Mode

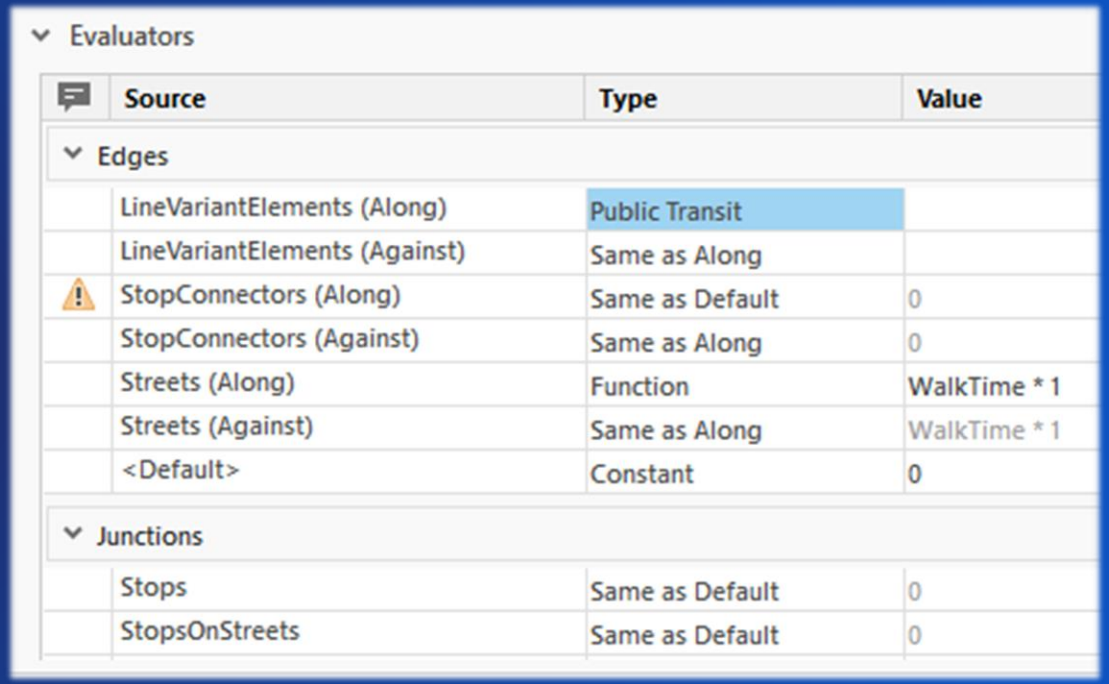


What is an evaluator?

- Tells the network how to calculate the cost for each edge
- Performs some kind of calculation
- Configured individually for network dataset sources

What is the “Public Transit” evaluator?

- Calculates cost by querying the transit schedules
- Wait time + travel time for specific time of day
- Can only be used with LineVariantElements from public transit data model



Limitations of the public transit evaluator

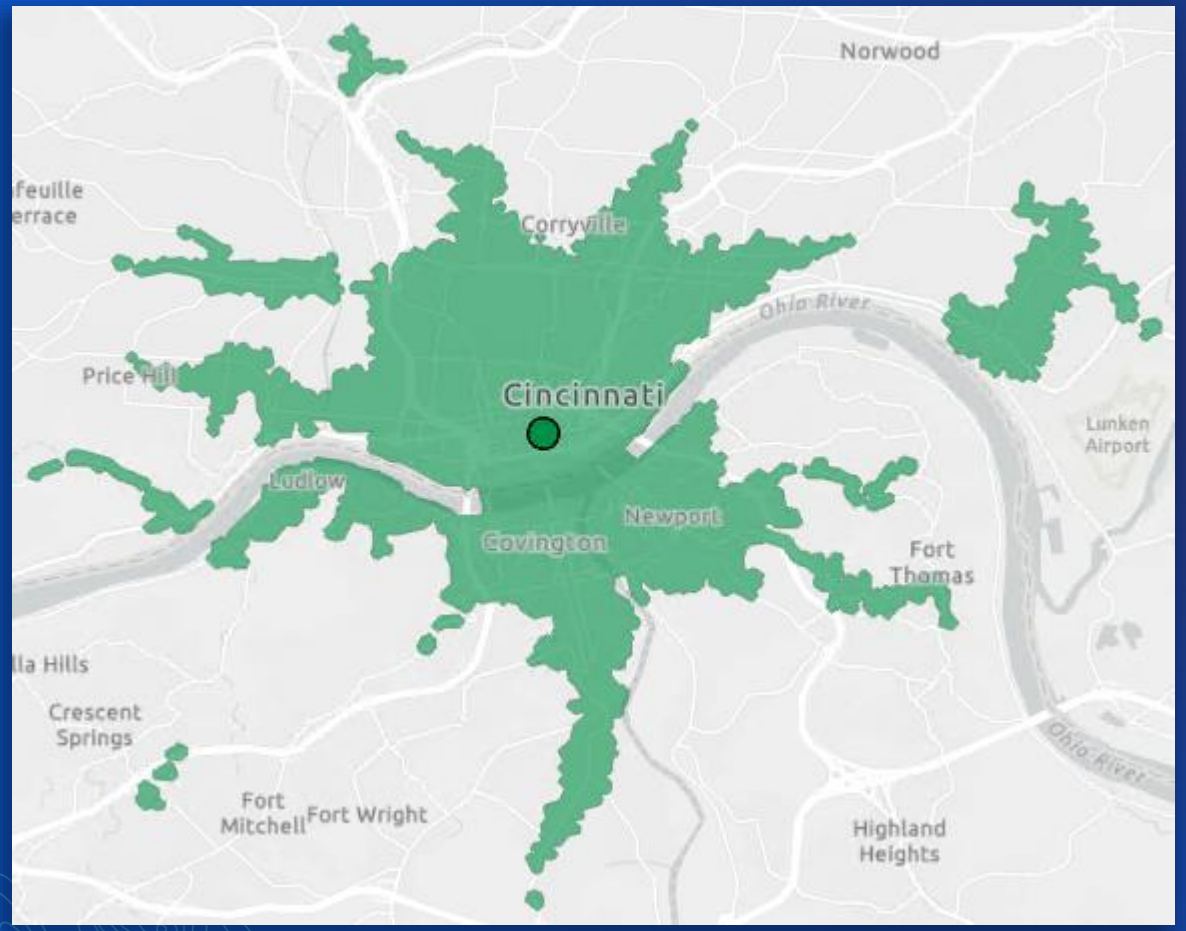
- No directions
- Cannot use with Route with optimized stop order (TSP) or with the Vehicle Routing Problem (VRP)
- Cannot separately limit walk time and overall travel time
- Cannot limit transfers

Questions

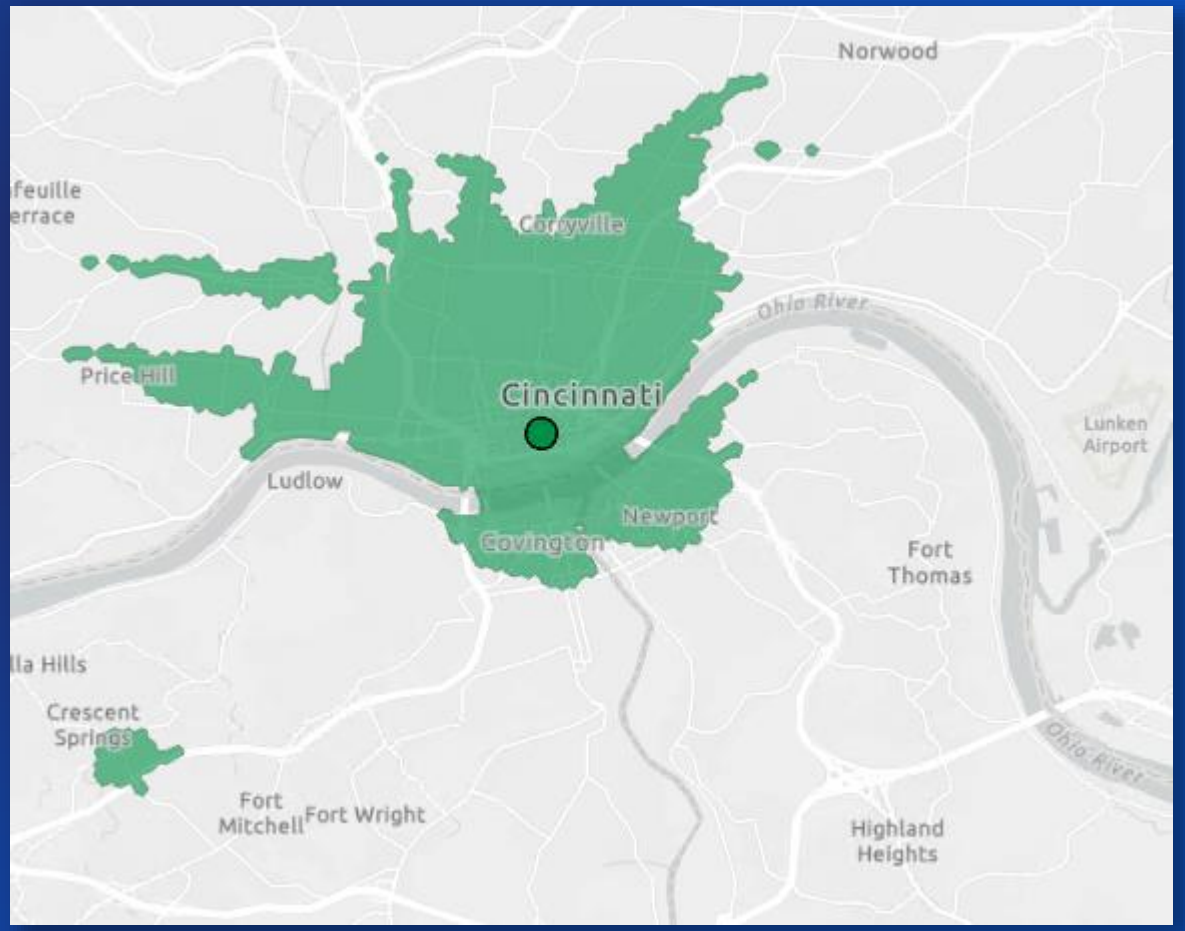
Example analysis: Analyzing access to jobs by public transit

Remember: Transit service areas differ by time of day.

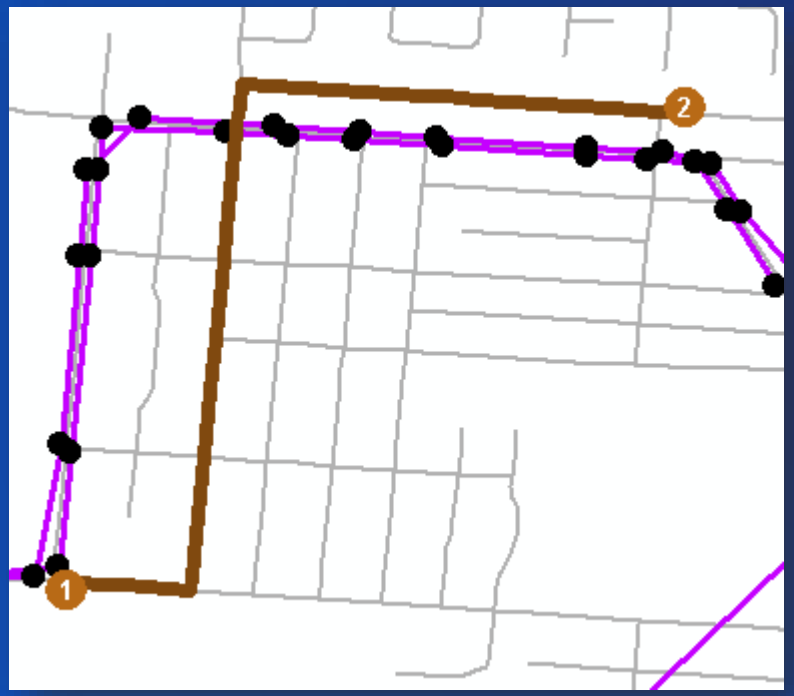
5:15 PM



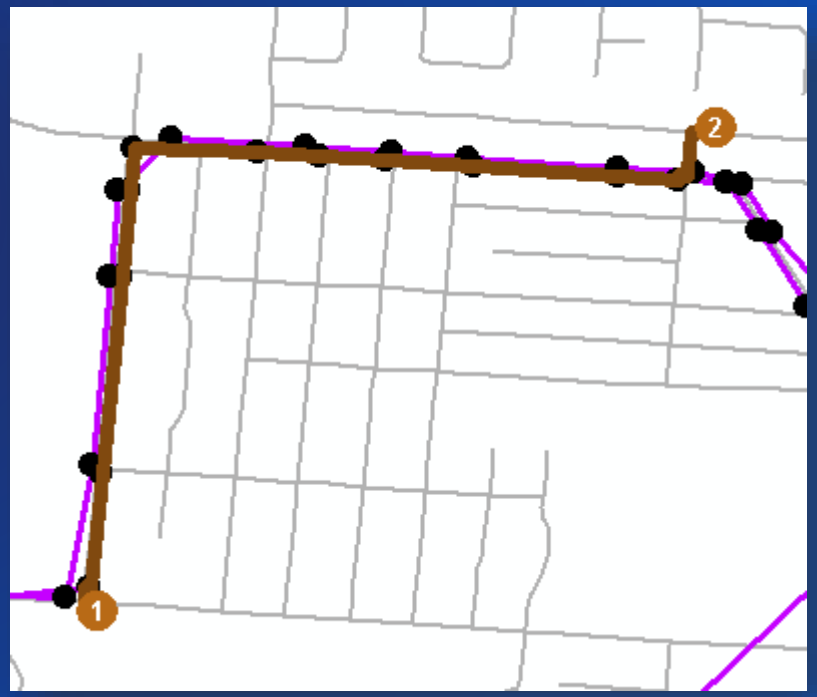
2:30 PM



Optimal route and travel time vary by time of day

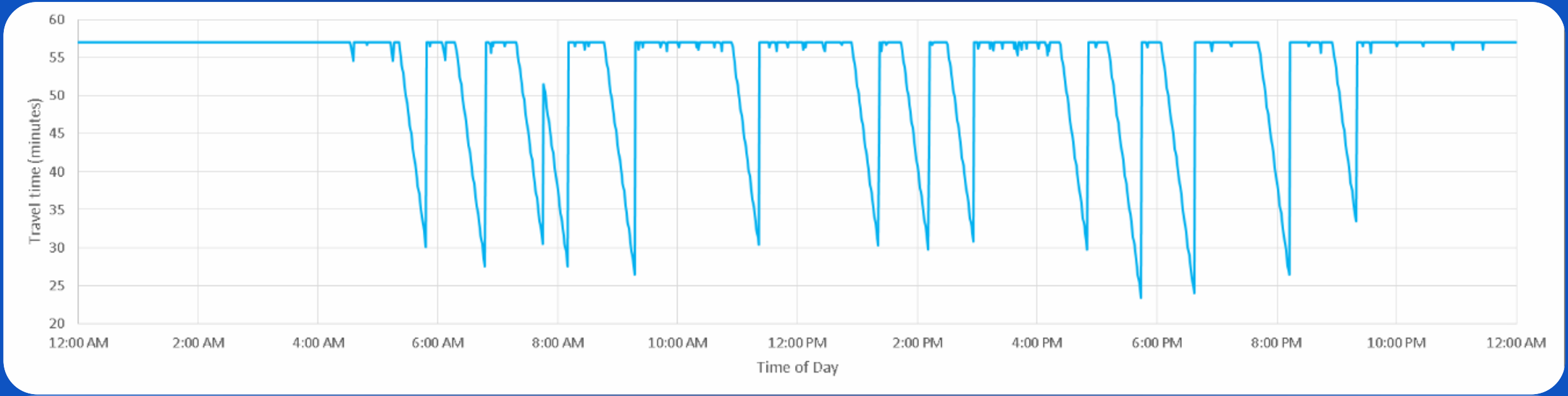


25 minutes



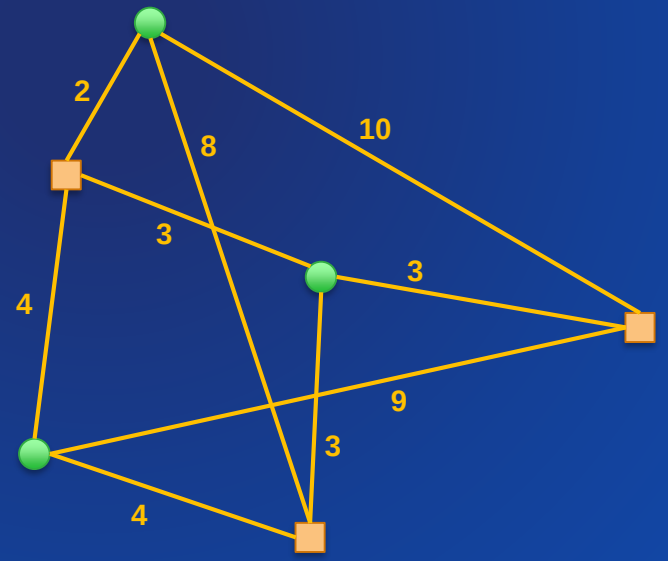
7 minutes

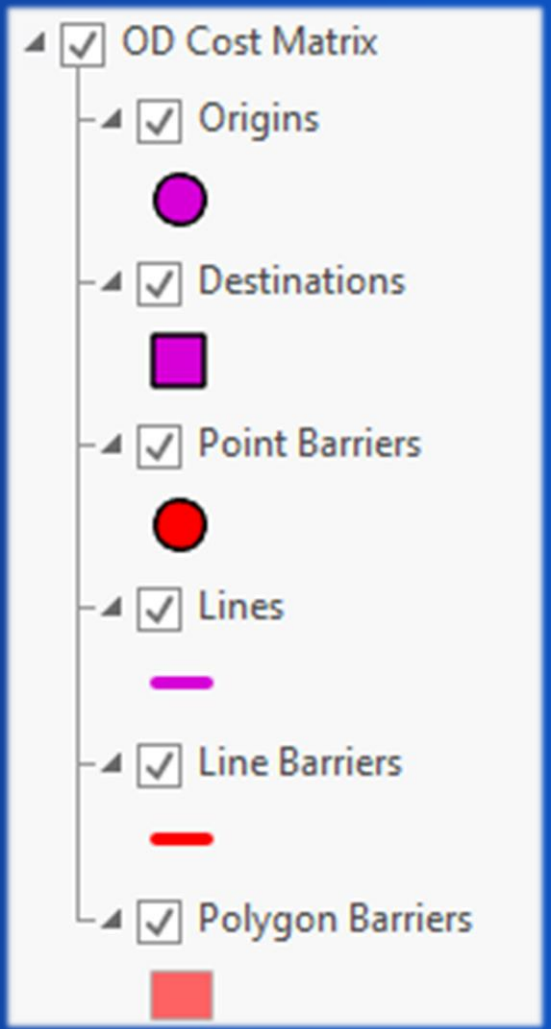
Travel time between two points varies



What is an Origin-Destination Cost Matrix?

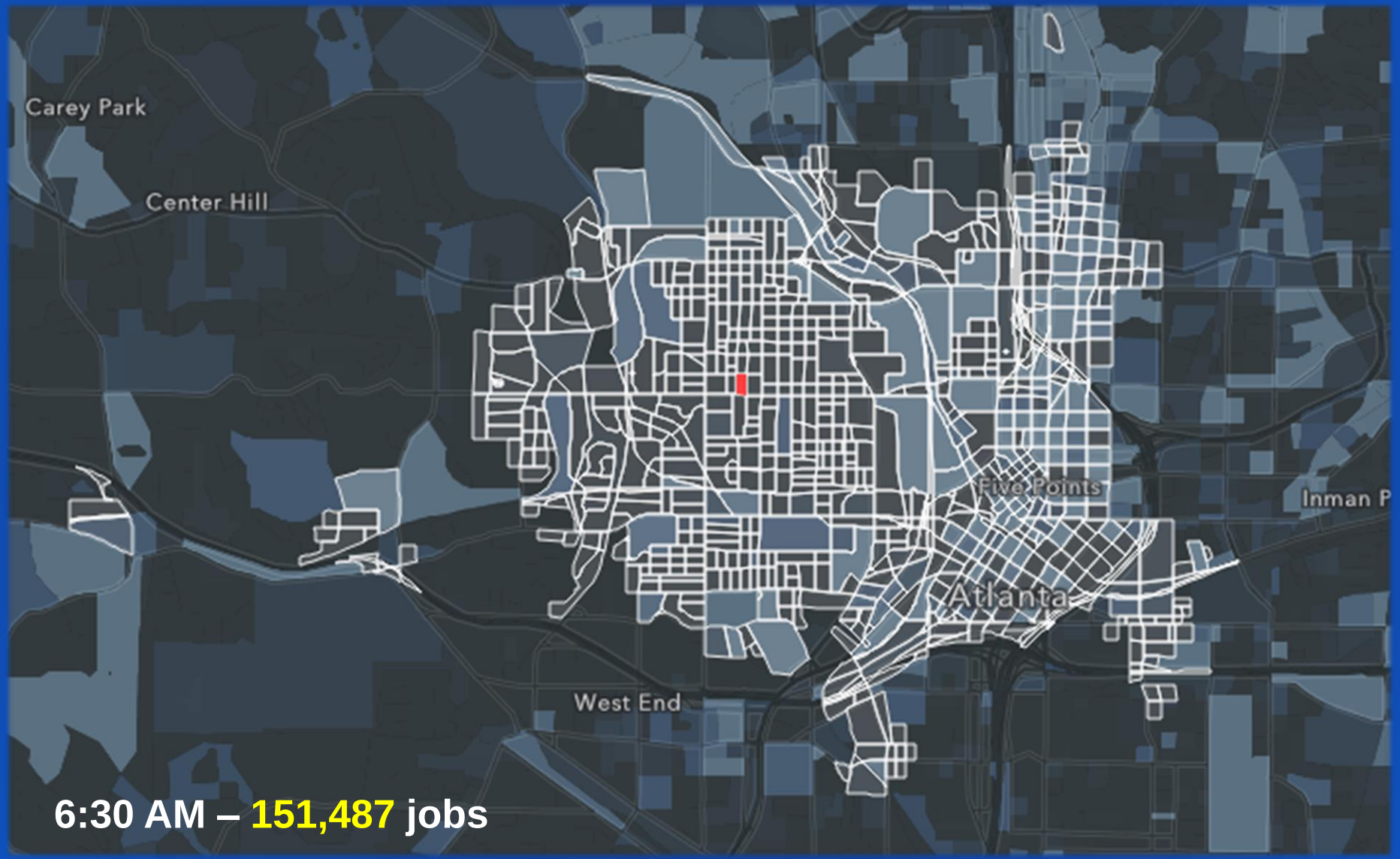
- Network Analyst tool
- Calculates travel time between each Origin and each Destination





Jobs reachable within 30 minutes

from a single census block



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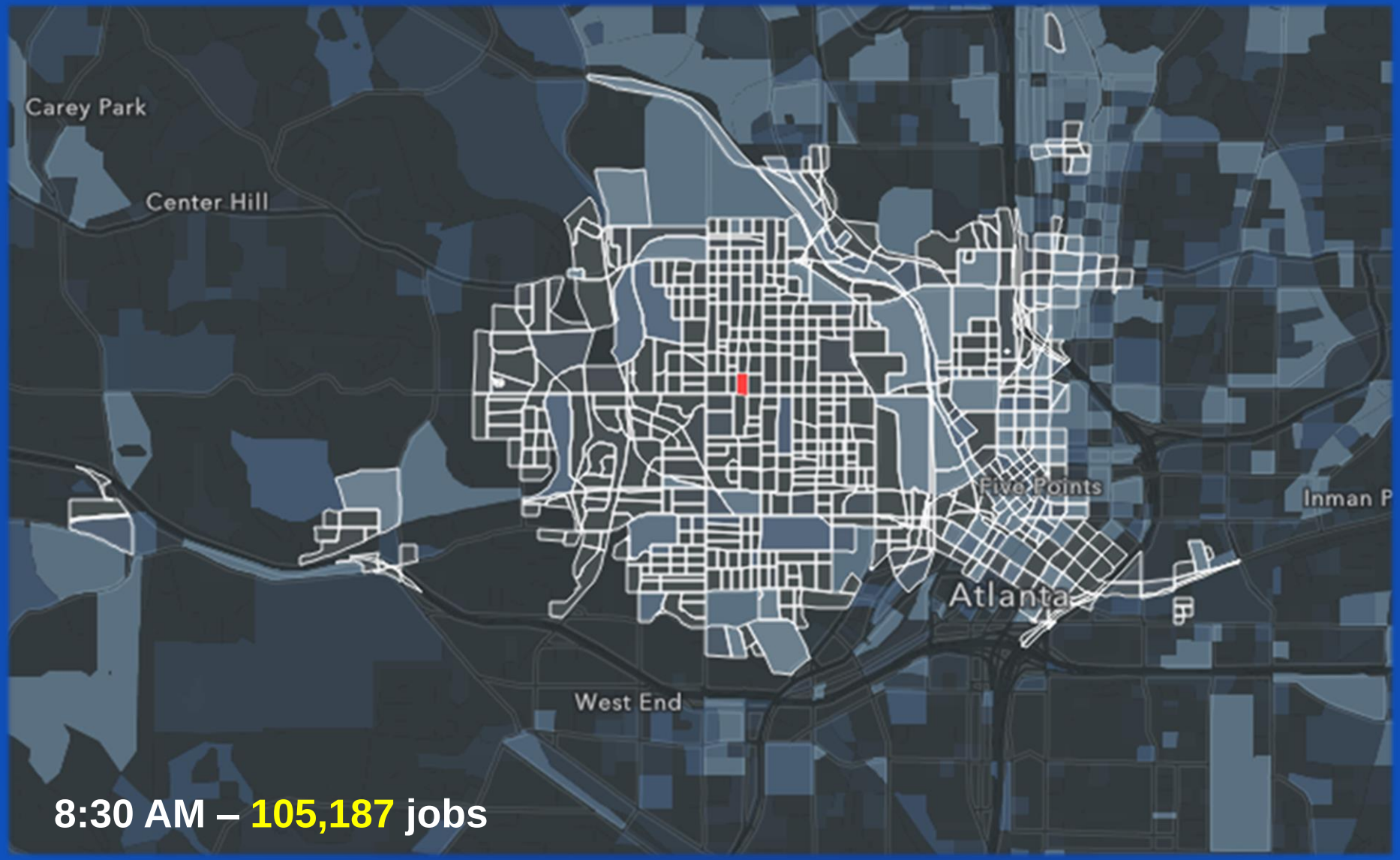
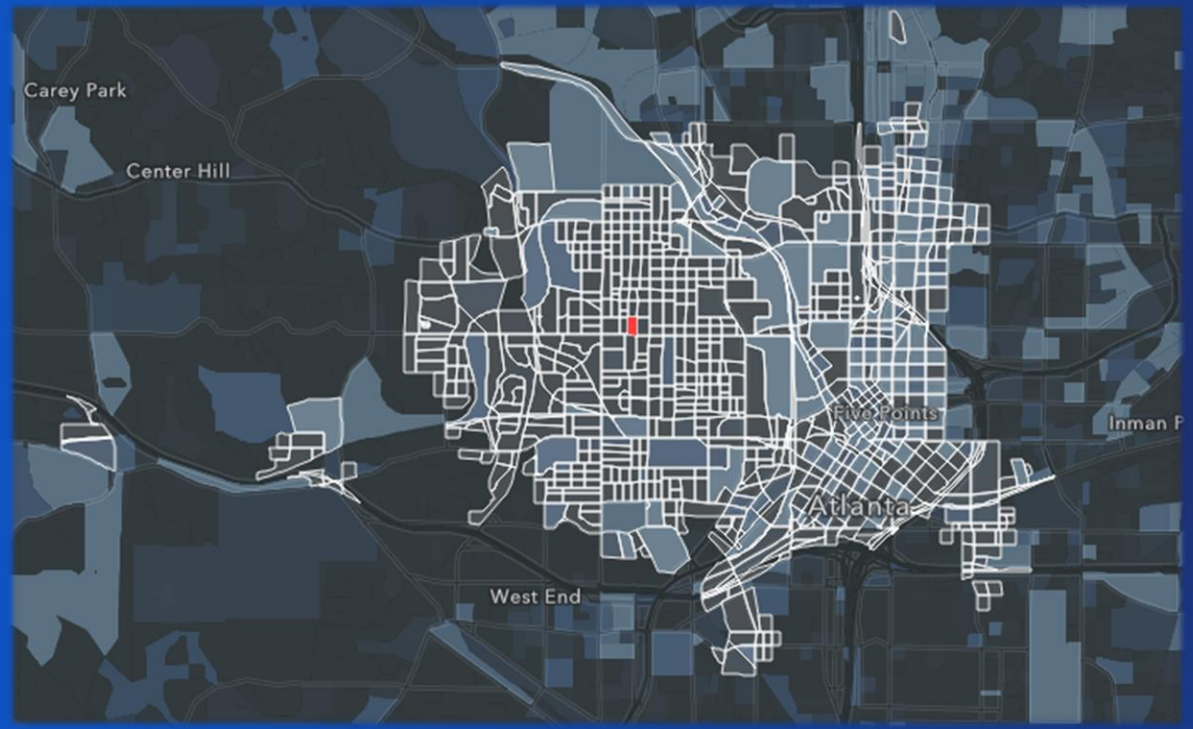


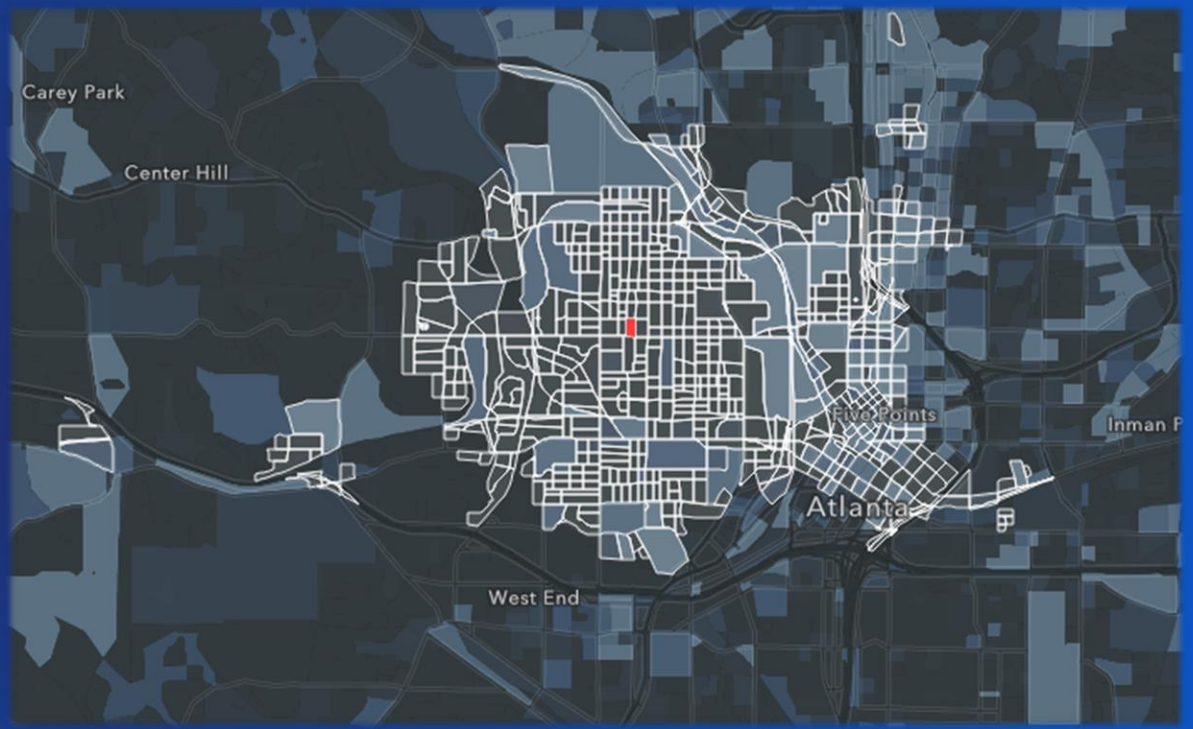
Jobs reachable within 30 minutes

from a single census block

6:30 AM – 151,487 jobs



8:30 AM – 105,187 jobs



Jobs accessible at least once between 6:30AM and 9:30AM:

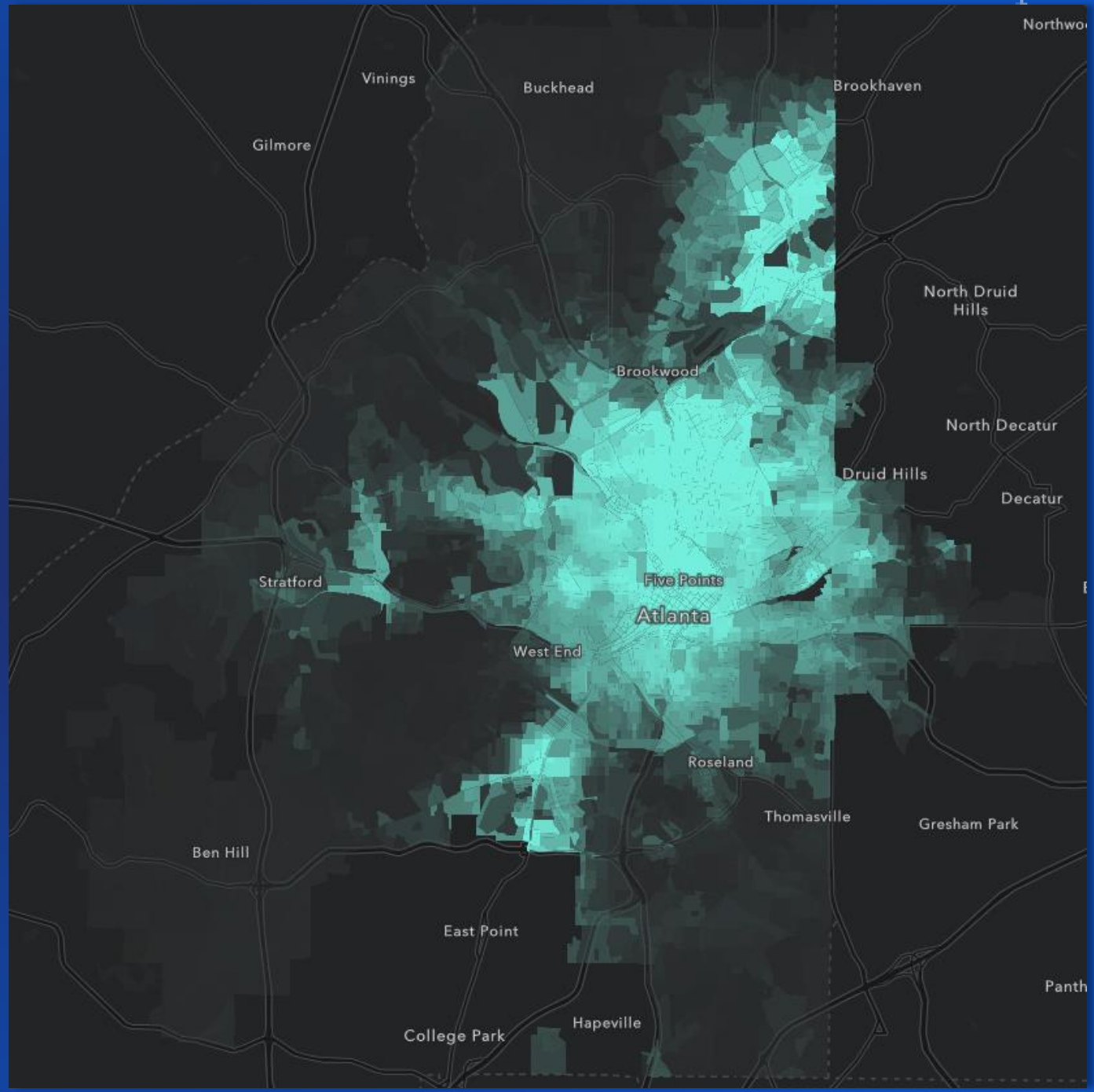
204,381

Jobs accessible at least 90% of start times:

67,680

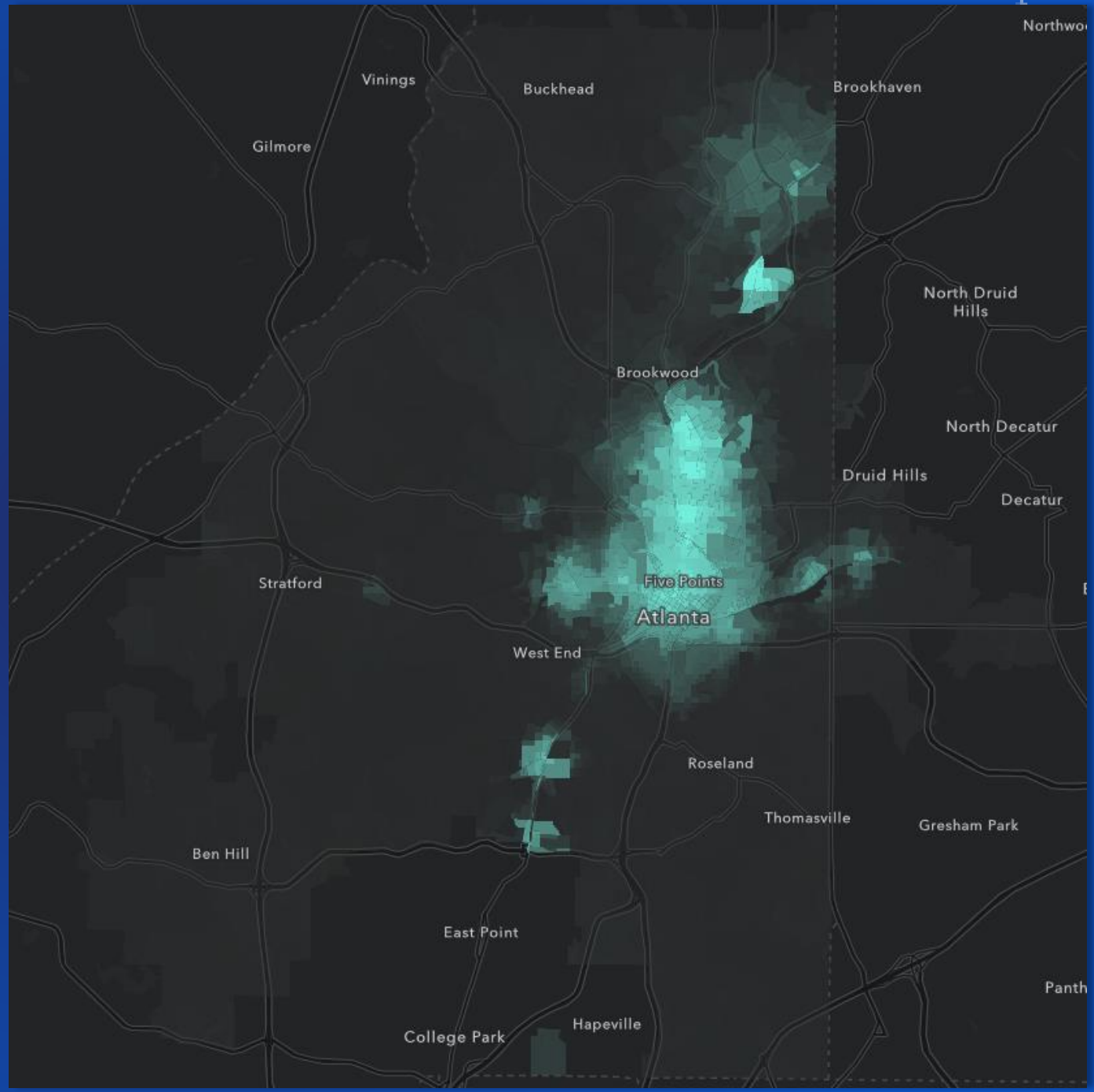
Jobs reachable at least once within 30 minutes

from every census block



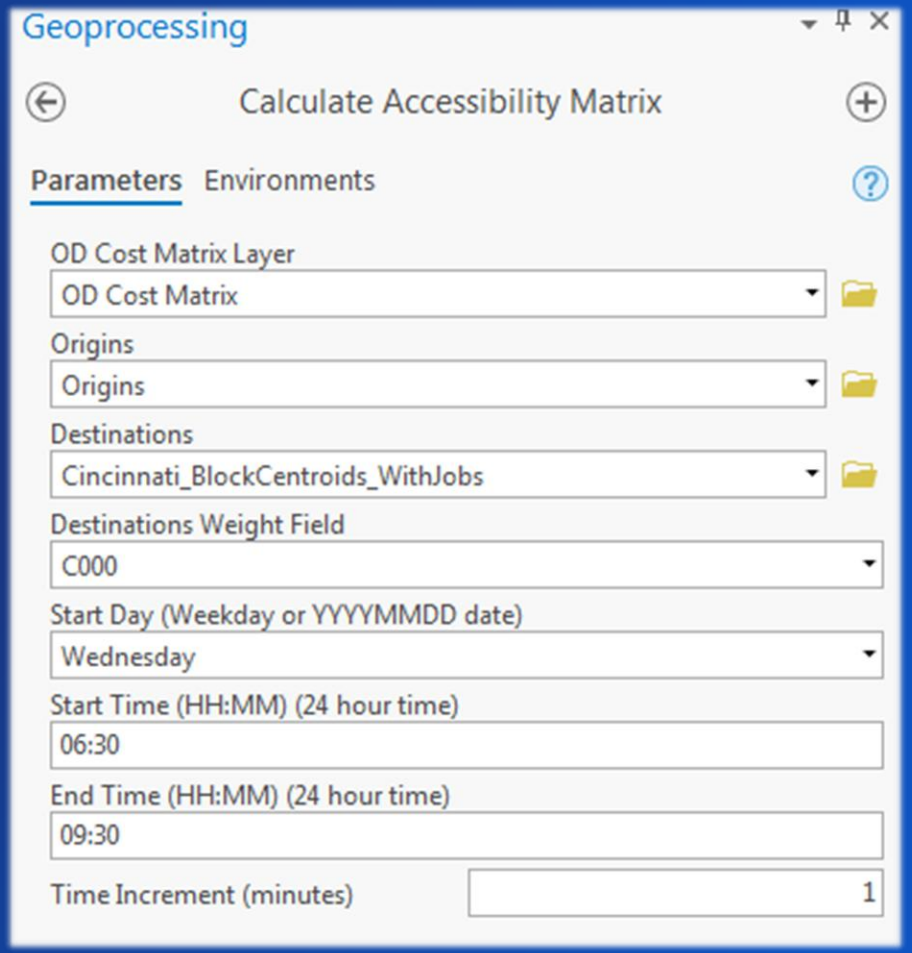
Jobs reachable frequently within 30 minutes

from every census block

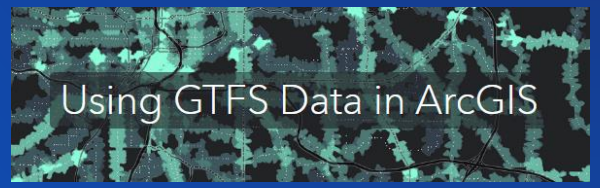


Calculate Accessibility Matrix tool

- Solve OD Cost Matrix
- Iterate through times of day
- Count number of destinations reachable
  - At least once
  - More than x% of times



Download at http://esri.github.io/public-transit-tools/ (part of the Transit Network Analysis Tools toolset)



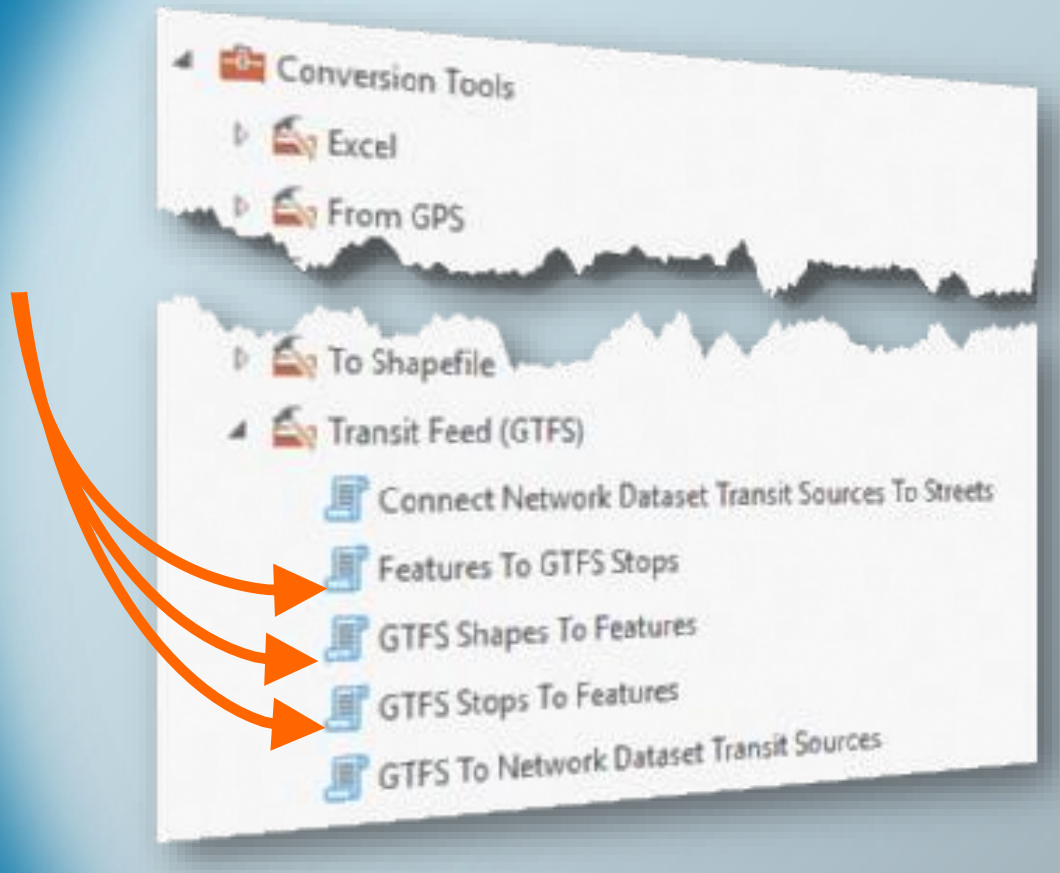
Questions?

Other Cool Things

Other GTFS tools in ArcGIS Pro

For displaying and editing GTFS data

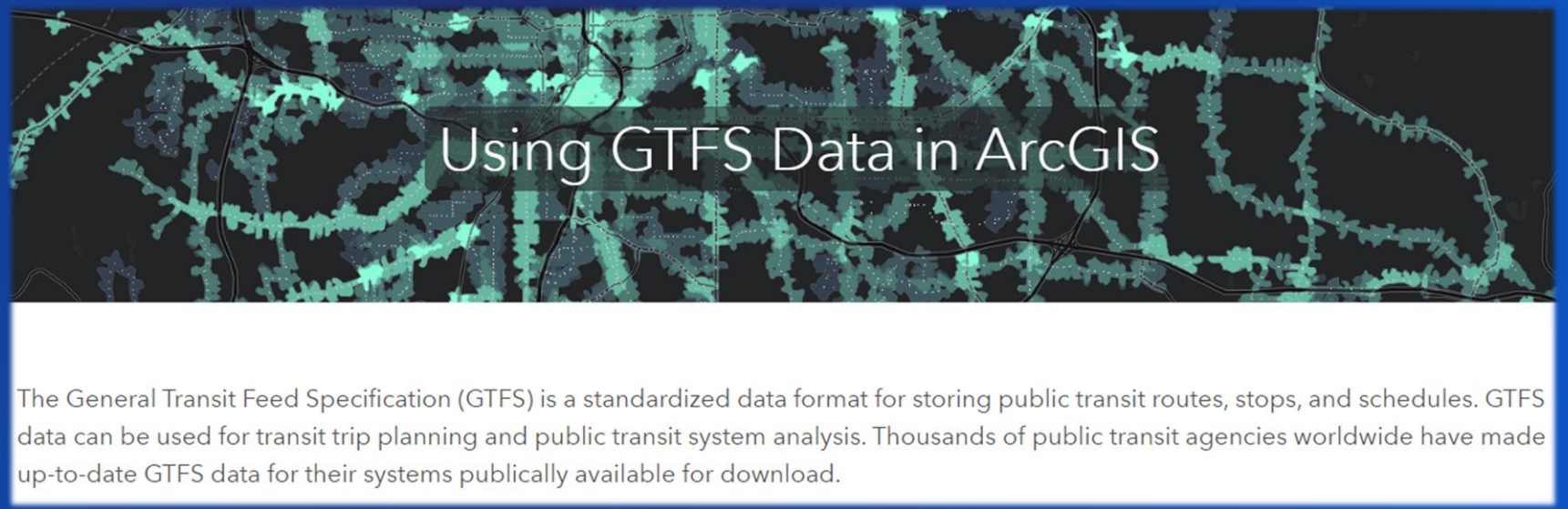
- Located in the Conversion Tools toolbox in the Transit Feed (GTFS) toolset
- Displaying data
  - GTFS Shapes To Features
  - GTFS Stops To Features
- Editing GTFS stops
  - Features to GTFS Stops



Other downloadable tools

And sample analyses…

- **Downloadable tools for transit analysis and editing**
- **Sample analyses**
- **Links to other resources**

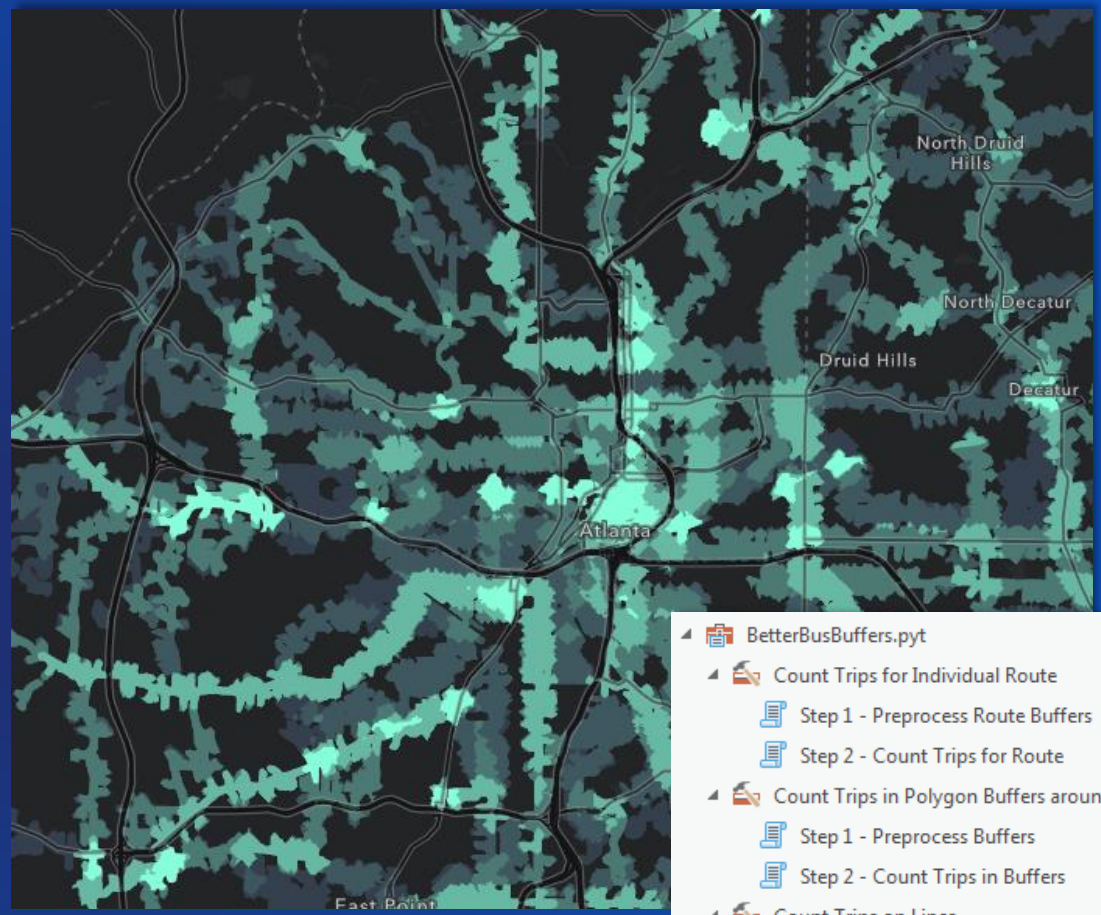


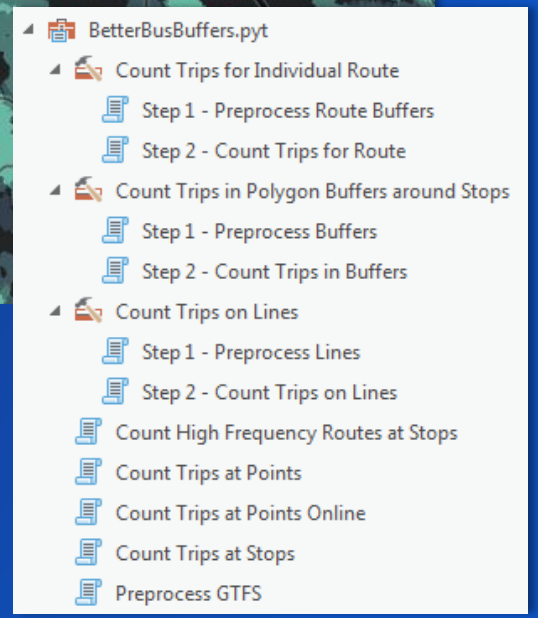
Download tools from

https://esri.github.io/public-transit-tools/index.html

BetterBusBuffers

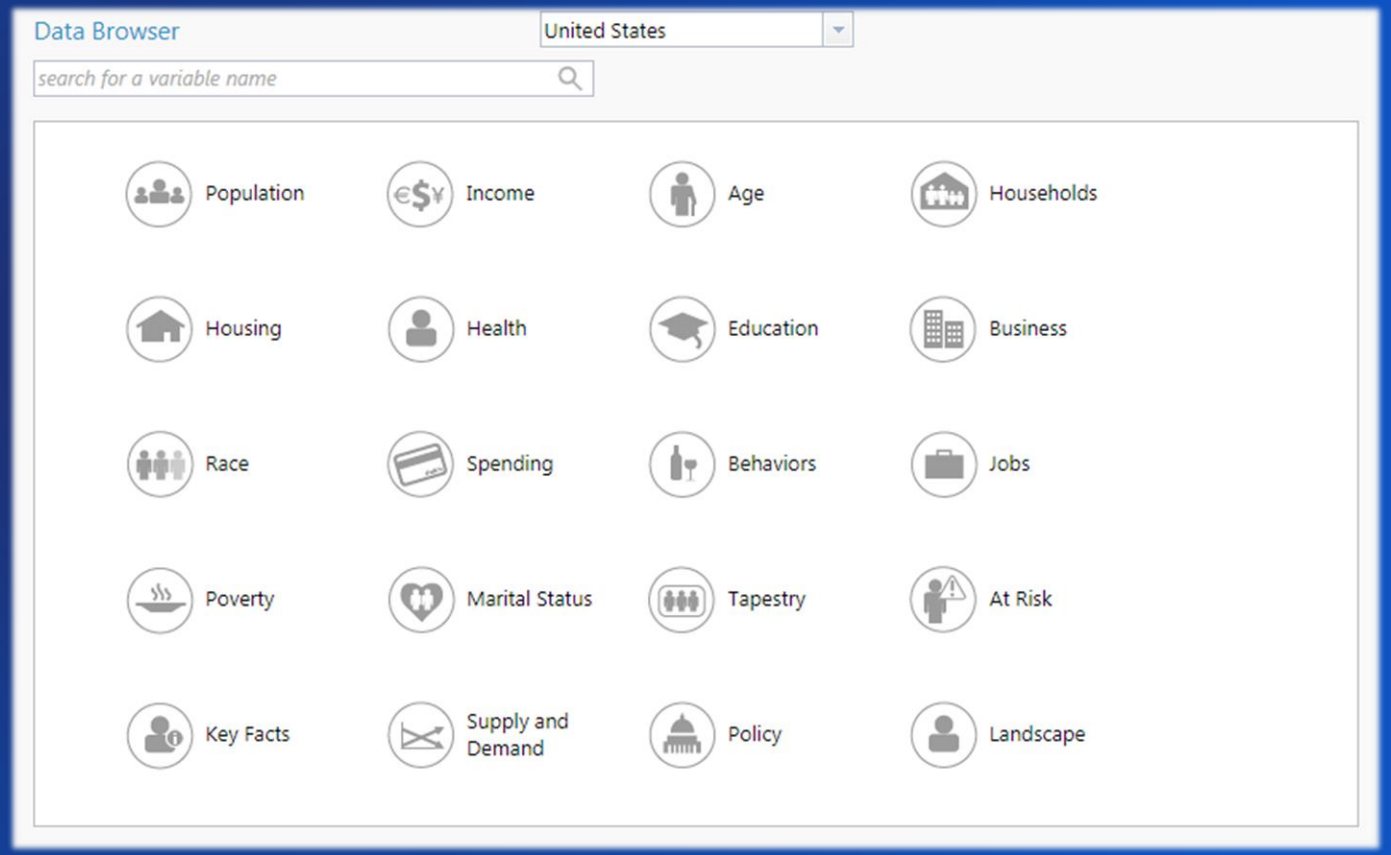
- Count how many trips per hour visit my stops during a time window
- Weight my system's service area map by frequency
- Calculate the frequency of service available at points of interest





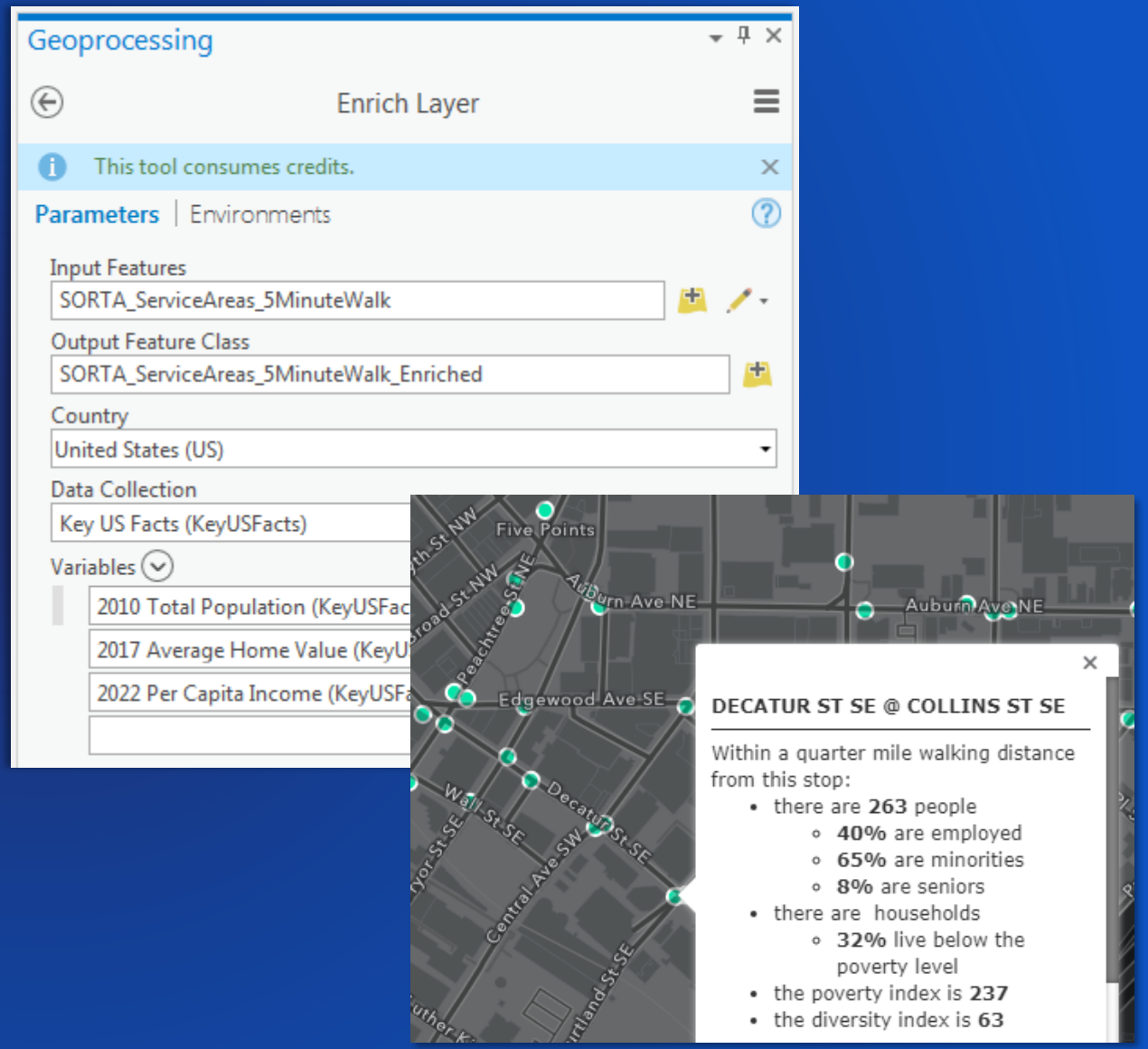
Esri Demographics

- Demographic data
- Business data
- Current
- Worldwide
- Derived from Census, ACS, and many other sources
- Curated by a team of experts



Data enrichment

- Add demographic data to arbitrary polygons (or points!)
- Enrich Layer tool
  - ArcGIS Pro
  - ArcGIS Online
- Uses service credits



Wrap-up

Resources

Tutorial
http://esriurl.com/TransitTutorial

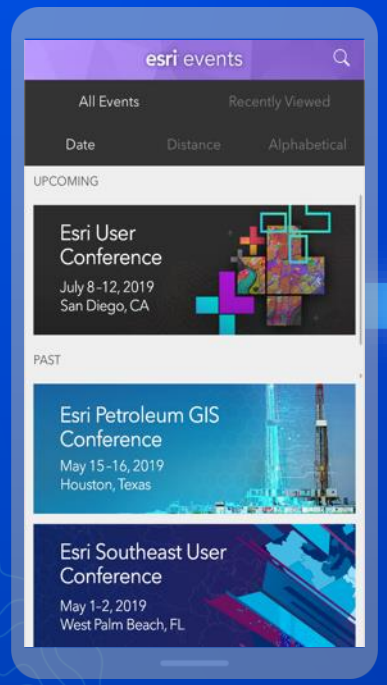
Downloadable tools

https://esri.github.io/public-transit-tools/index.html

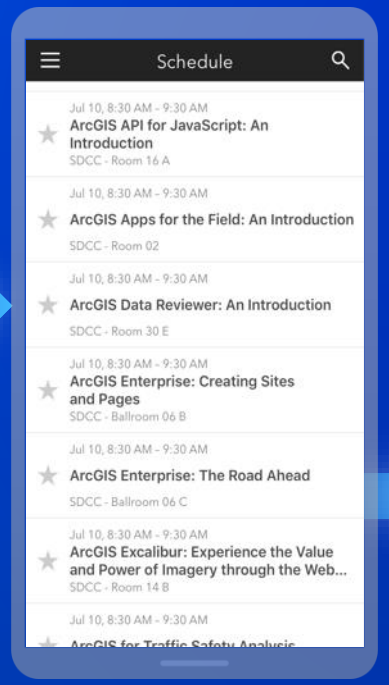
GeoNet group
https://community.esri.com/community/arcgis-for-public-transit

Please Share Your Feedback in the App

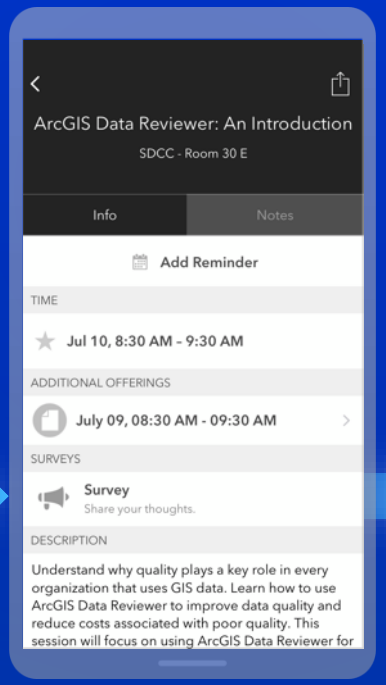
Download the Esri Events app and find your event



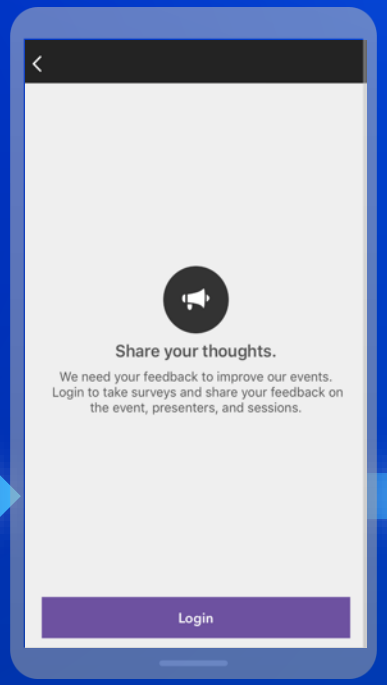
Select the session you attended



Scroll down to "Survey"



Log in to access the survey



Complete the survey and select "Submit"